PORTABLE WOOD RECOVERY AND DE-LEADING SYSTEM

FIELD OF THE INVENTION

[0001] The present invention relates to wood processing, and more particularly to cleaning contaminated lumber.

BACKGROUND OF THE INVENTION

[0002] Lead-based paint is a known health hazard. Because older wood structures typically use lead-based paint, deconstruction and removal of these structures are hazardous activities. To avoid liability, a contractor must handle, contain, and dispose of the hazardous wood according to federal and state requirements.

[0003] Yet lead-painted structures often contain high quality lumber that, if salvaged, offers a beneficial resource from the hazardous waste of deconstruction. Wood recovery techniques have been developed to recycle the hazardous lumber into clean, sized stock and to safely contain the leaded waste for proper disposal. Moreover, recovery techniques have been developed that are portable to the site of deconstruction, which facilitates efficient processing and minimizes human contact with, and transportation of, the contaminated material.

[0004] U.S. Patent No. 5,507,122 to Aulson discloses, for example, a de-leading unit having a mobile trailer and multiple woodworking devices therein, including a wood planer, chop saw, and table saw. The trailer has a receiving port to intake lead-painted wood and an exit port for feeding the de-leaded wood to workers outside the trailer.

[0005] While conventional systems such as the '122 patent can be effective, they have many shortcomings. For example, workers are often required within the trailer to manipulate lumber through various passes of separate woodworking devices, thereby exposing workers to airborne toxic debris concentrated within the trailer. Multiple woodworking devices and multi-pass processing also increase cost, potential for injury, and likelihood of error.

[0006] Moreover, current wood de-leaders generally lack a robust design necessary for efficient processing of deconstructed woods, which tend to have embedded metals and non-uniform slippery surfaces. One cause of inefficiency is the use of planers having round feed rollers with

limited contact area and traction to drive wood. Accordingly, typical de-leaders often allow deconstructed wood to slip during the drive operation, which requires manual attention and generates error in the finished woodpiece. Moreover, current de-leaders use standard cutting blades that exhibit premature wear when processing coated wood and damage when contacting embedded nails and metals. These blades cut whole pieces of waste that are cumbersome for safe handling, containment, and disposal.

[0007] Another drawback of current wood de-leaders is an inability to automatically process different, odd-shaped wood common to a deconstruction site. For example, deconstructed wood can range in size and shape with irregular contoured surfaces, such as in moldings and architectural woodwork. If at all capable, current de-leaders require continual adjustment and multiple passes to process the varying woodpieces, which slows processing, increases the volume of contaminated dust to control, and increases hazardous exposure to workers. Moreover, the drive mechanisms in de-leaders are typically unstable when driving wood with irregular shape.

[0008] In addition, current de-leaders often cannot process wood beyond a threshold length. The de-leading unit of the '122 patent is so limited due to the trailer's internal dimensions and layout. Since longer wood has increasing recovery value, any limitation to wood length is counter productive to the recovery concept. Moreover, conventional de-leaders usually have excessive dimensions that hinder efficient portability to crowded urban work sites.

[0009] There is thus a need for an improved wood recovery and de-leading system having increased efficiency, robustness, versatility, compactness, cost effectiveness, and safety.

SUMMARY OF THE INVENTION

[0010] The present invention generally provides a wood de-leading device for de-leading a woodpiece. In one embodiment, the device includes a container having an inlet opening and an outlet opening. A plurality of rotatable wood removal cutters are located between the inlet and outlet openings, adapted to remove wood from different orientations of the woodpiece traveling in use along a feed path substantially aligned between the inlet and outlet openings. A drive mechanism is adapted to automatically drive the woodpiece along the feed path towards and beyond the cutters to the outlet opening in a single pass.

[0011] According to another embodiment, the wood de-leading device includes a mobile trailer having an inlet opening and an outlet opening. A plurality of rotatable wood removal cutters are located between the inlet and outlet openings, adapted to remove wood from different orientations of the woodpiece traveling in use along a feed path substantially aligned between the inlet and outlet openings. A drive mechanism adapted to automatically drive the woodpiece from the inlet opening along the feed path towards the plurality of rotatable wood removal cutters to the outlet opening in a single pass. A vacuum mechanism is included to maintain the trailer at a pressure lower than the ambient pressure (i.e., a negative air pressure with respect to the ambient pressure).

[0012] In another aspect of the invention, a method is provided for removing paint from a woodpiece. The method uses a container having an inlet opening and an outlet opening, with a wood de-leading device housed within the container. The method includes receiving the woodpiece through the inlet opening, driving the woodpiece from the inlet opening through the wood de-leading device, de-leading at least two surfaces of the woodpiece, and finally, outputting the woodpiece to the outlet opening. The driving, de-leading, and outputting are in a single automatic pass of the woodpiece along a feed path in substantial alignment with the inlet opening and outlet opening. Therefore the present invention provides the advantage that no workers are required within the trailer for system operability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0014] FIG. 1 is a perspective view of a wood de-leading device, compatible with the preferred embodiment of the invention.

[0015] Fig. 2 is a detailed top view of the wood de-leading device of FIG. 1.

[0016] FIG. 3 is a detailed side view of the wood de-leading device of FIG. 1.

[0017] FIG. 4 is a perspective view of a wood recovery and de-leading system, compatible with the preferred embodiment of the invention.

[0018] FIG. 5 is a top view of a consolidated wood recovery and de-leading system, compatible with the preferred embodiment of the invention.

[0019] FIG. 6 is a side view of the consolidated wood recovery and de-leading system of FIG. 5.

DETAILED DESCRIPTION OF THE INVENTION

[0020] The present invention generally provides a wood recovery and de-leading system for de-leading deconstructed wood into clean, sized, and optionally profiled stock in a single pass, while containing the hazardous waste for safe and efficient processing and disposal. Although the system is described as operating on wood, a person having ordinary skill in the art will appreciate that the system can be used to clean and resize any number of materials regardless of coatings thereon.

[0021] The wood recovery and de-leading system includes a wood de-leading device 10, an example of which is shown in perspective view by FIG. 1. FIGS. 2 and 3 show top and side views, respectively, of a preferred embodiment of the wood de-leading device. As shown in these figures, the wood de-leading device 10 has a plurality of wood removal cutters 12-15, and a drive mechanism 18 for feeding a lead-painted woodpiece 20 towards the cutters. The cross section of the woodpiece as it is being fed through the wood de-leading device defines a feed path through the device.

[0022] Referring to FIGS. 1-3, the wood removal cutters 12-15 are disposed along the feed path in different planes with a common direction of wood removal. Each cutter is positioned to remove wood from a desired orientation (e.g., top, bottom, or side) of the woodpiece 20 as it travels along the feed path. In the illustrated embodiment, the wood de-leading device includes four cutters 12-15. The first cutter 12 and second cutter 13 remove portions from the top and one side of the incoming woodpiece 20a, respectively, thereby defining the height and width of the finished woodpiece 20b. The third cutter 14 removes wood from an opposed side of the woodpiece, while the fourth cutter 15 removes a bottom portion thereof. Though four wood removal cutters 12-15 are shown in FIGS. 1-3, the wood de-leading device preferably includes at least a top cutter and a side cutter to define the height and width of the finished woodpiece 20b, as mentioned. Those having ordinary skill in the art will understand that further adjustment of

woodpiece width can be provided by including an adjustable guide fence 22 to support and guide one side of the woodpiece as it passes through the wood removal cutters.

[0023] In a preferred embodiment, any wood removal cutter 12-15 can be adjustable to remove a desired amount of wood from the respective orientation of the woodpiece. For example, the cutters can be adjusted to resize (and de-lead) the woodpiece into lumber having any dimension, such as $^{5}/_{8}$ inch by 3 $^{3}/_{4}$ inch stock. Those having ordinary skill in the art will appreciate various means for providing such adjustability to a cutter, for example, via a hand crank 24 as shown. Although the wood removal cutters are described as being configured to provide a finished woodpiece 20b having a rectangular or square cross-section, the cutters can be otherwise configured to provide a finished woodpiece having any cross section. Moreover, those having ordinary skill in the art will understand that the wood removal cutters are preferably adapted to impress any desired profile (e.g., contour) to the finished woodpiece 20b.

[0024] The wood de-leading device 10 has a robust design particularly effective to withstand the heightened demands called upon by the unique attributes of deconstructed wood, such as embedded metals, slippery surfaces, irregular shapes, and heavy stock removal. For example, in the preferred embodiment, the wood removal cutters 12-15 are composed of a material rigid enough to remove wood but pliable enough to avoid premature wear (e.g., chipping) when processing embedded metals and rough coatings common to deconstructed wood. In a particularly effective embodiment, the wood removal cutters are constructed of a soft carbide material. Those having ordinary skill in the art will appreciate other cutter materials having similar ability to avoid premature wear when processing deconstructed wood.

[0025] The wood removal cutters can include standard saw blades having a typical shape. However, such blades remove whole portions of wood, which complicates waste containment and safety. To overcome this difficulty, in the preferred embodiment, the wood removal cutters can include so-called hogging cutters, which are thicker than standard saw blades. A hogging cutter operates not by sawing off a whole portion of the woodpiece, but rather, by pulverizing the removed wood into dust, chips, and shavings more easily contained for efficient disposal. If used, a hogging cutter can be configured to any thickness for a desired amount of wood removal.

[0026] Due to course coatings, embedded metals, slippery surfaces, and heavy stock removal, deconstructed wood tends to resist feeding through the wood removal cutters 12-15 and to resist

traction with the drive mechanism 18 of the wood de-leading device 10. These complications are aggravated by the inefficient design of conventional drive mechanisms, which use feed rollers having minimal tangential drive contact with the woodpiece. As a result, conventional drive mechanisms often slip during the feed operation. To overcome this problem, the present invention provides a wood de-leading device 10 having a drive mechanism 18 configured to feed deconstructed wood through the cutters 12-15 with improved traction and stability.

[0027] In the preferred embodiment, the drive mechanism 18 is adapted for distributed driving contact along a first surface of the woodpiece. As shown in FIGS. 1-3, the drive mechanism can include a feeding conveyor 30, e.g., a continuous belt or chain drive, having a traction surface 32 for such driving contact. The traction surface preferably includes cleats 34 having a rough surface with optional barbs, hooks, or spikes (not shown), to grip the woodpiece during the feed operation. Those having ordinary skill in the art will appreciate other ways to configure the feeding conveyor 30 with a traction surface for improved grip and stability while driving the woodpiece.

[0028] In the preferred embodiment, the traction surface 32 of the drive mechanism 18 ranges along the feed path of the wood de-leading device, adjacent to at least the top and side wood removal cutters. Of course, the position of the traction surface can be anywhere before, during, and/or after any of the cutters sufficient to drive the woodpiece 20 beyond all of the cutters during operation. Extending the traction surface beyond the cutters facilitates feeding the finished woodpiece 20b through to the outlet. Without so extending the traction surface, such feed-through of the woodpiece is aided by abutting successive woodpieces in a continuous manner, such that each incoming woodpiece pushes the finished woodpiece 20b beyond the traction surface 32 to the outlet.

[0029] To further facilitate positive feeding of the woodpiece, the wood de-leading device 10 can include an urging device 38 adapted to increase frictional forces between the woodpiece 20 and the traction surface 32 of the drive mechanism 18. In the preferred embodiment, the urging device 38 is a set of rollers adapted to urge the woodpiece against the traction surface 32 of the feeding conveyor 30 during use. The rollers can be configured to urge the woodpiece in any direction that increases feed traction. Preferably, the rollers urge the woodpiece in a direction substantially orthogonal to the traction surface 32 of the feeding conveyor 30. Note that the

urging device 38 is not limited to rollers. Those having ordinary skill in the art will appreciate objects shaped other than rollers to likewise provide the urging force while not resisting feed-through of the woodpiece 20.

[0030] To allow for irregular topologies of a woodpiece, the urging device 38 can be configured with automatic conforming adjustment. In the preferred embodiment, coupled to each urging roller 38 is a bias mechanism 40 adapted to bias the roller against the woodpiece, with a range of travel having a component in the urging direction. So configured, the roller 38 provides the urging force while automatically adjusting its position to accommodate any irregularity in the topology of the incoming woodpiece 20a. The urging device can have a range of travel in the urging direction from about a quarter inch to about several inches, and more preferably, about 2 inches. Though in FIG. 1 the bias mechanism 40 is shown symbolically as a spring, it is understood that the bias mechanism 40 can be any known means for providing a bias force to the rollers. In the preferred embodiment of FIGS. 2-3, the bias mechanism 40 includes a spring-loaded swing arm 40a that biases the roller with a range of travel along an arc toward the woodpiece. Those having ordinary skill in the art will appreciate other assemblies and mechanisms to likewise provide the urging device with automatic conforming adjustment, such as hydraulically or pneumatically operated devices, vacuum and air pressure devices, and the like.

[0031] To prevent unwanted kickbacks of a woodpiece passing through the cutters, the wood de-leading device can include an anti-kickback mechanism 42. The anti-kickback mechanism is configured to allow free passage of the woodpiece 20 in the feed direction while preventing movement of the woodpiece in the opposite direction. In the preferred embodiments of FIGS. 1-3, the anti-kickback mechanism 42 includes pointed fingers that drive into the surface of the woodpiece if it moves opposite to the feed direction. Those having ordinary skill in the art will understand other ways of configuring the anti-kickback mechanism to prevent kickback of the woodpiece during the drive operation.

[0032] To prevent dangerous projectiles of debris during processing, the wood de-leading device 10 can include a self forming anti-projectile mechanism. In a preferred embodiments of FIGS. 1-3, the anti-projectile mechanism includes an anti-flyback curtain 44 having a blocking surface. The blocking surface can have various orientations with respect to the wood removal cutters 12-

15 for blocking respective directions of debris projectiles. As shown, the anti-flyback curtain 44 is preferably oriented with its blocking surface in a plane substantially orthogonal to the feed direction, located before the cutters to prevent projectiles toward the input of the device 10. Of course, this anti-projectile mechanism can be located in other positions with respect to the wood removal cutters 12-15 to likewise block projectiles in other vicinities of the wood de-leading device 10.

[0033] The wood de-leading device is housed in a container to facilitate portability and hazardous waste management. FIG. 4 shows a perspective view of the preferred embodiment, where the container is a mobile trailer 46 having dimensions suitable for road use and for portability to the immediate site of raw material, e.g., the deconstruction site. Preferably, the trailer 46 has a length from about 10 feet to about 40 feet, more preferably about 28 feet. Though depicted in the figures and described below as being a trailer, the container 46 can be any object capable of housing the wood de-leading device 10 and containing waste.

[0034] Referring to FIG. 4, disposed within the trailer 46 are an inlet opening 48 and an outlet opening 50 for receiving and outputting a woodpiece, respectively. The wood de-leading device 10 is positioned with its feed path substantially aligned between the inlet and outlet openings, to enable a woodpiece 20 having any given length to pass in a straight line from the inlet to the outlet of the trailer while being processed by the de-leading device therebetween. In the illustrated embodiment, the wood de-leading device is so aligned between the inlet 48 and outlet 50 openings, which are disposed on opposed sides of the trailer 46. Of course, the wood de-leading device can be substantially aligned with inlet and outlet openings positioned differently, e.g. on adjacent sides of the trailer, as long as the wood de-leading device 10 can receive a deconstructed woodpiece 20 from the inlet 48 and automatically process the woodpiece through to the outlet 50 in a single pass.

[0035] In the preferred embodiment, the trailer is configured to provide the wood recovery and de-leading system as a consolidated unit for efficient safety and operation. FIGS. 5-6 show top and side views, respectively, of a preferred embodiment. Beyond an electrical generator 52 and fire suppression system, the trailer 46 preferably includes a waste management system to facilitate safe storage and disposal of contaminated debris. The waste management system can include a side conveyor (not shown) adjacent to the wood de-leading device 10, for moving

sawed debris to a waste containment cell 56 within the trailer 46. Instead of a side conveyor, a vacuum channel could be similarly positioned to move debris to the waste containment cell. In the preferred embodiment, the waste containment cell can be transferred to and from the trailer via a mechanized loader 58. To prevent waste from escaping the trailer during such transfer, the mechanized loader 58 is preferably coupled to the trailer 46 with a sealed connection, as will be understood by those having ordinary skill in the art.

[0036] In the preferred embodiment, the trailer is configured with other optional features and systems that facilitate waste confinement and safety. For example, the inlet and outlet openings of the trailer preferably include access curtains and hatches: access curtains to limit waste from exiting the openings during use and access hatches to optionally seal the openings during periods of non-use. In the preferred embodiment of FIGS. 5-6, the trailer also includes an air management system having a HEPPA filter 60 and a vacuum mechanism 62. As will be understood by those having ordinary skill in the art, the HEPPA filter 60 is configured for efficient filtration of air debris throughout the volume of the trailer 46, while the vacuum mechanism 62 maintains the trailer at a pressure lower than atmospheric pressure.

[0037] In the preferred embodiment, auxiliary systems like an electrical generator, fire suppression system, vacuum system, air compressor, and the like, are housed within the trailer to provide a self contained de-leading unit. However, any or all auxiliary systems may be located outside the trailer, for example, in a separate container or trailer.

[0038] Referring to FIGS. 4-6, de-leading and recovery of a woodpiece is effected by having the inlet 48 opening of the trailer 46 receive a deconstructed woodpiece 20 having any length. With its feed path aligned with the inlet 48 opening, the wood de-leading device 10 receives the woodpiece from the inlet and automatically drives the woodpiece through the wood removal cutters 12-15 to the outlet opening of the trailer 46 in a single pass. As mentioned above, woodpieces can be inputted in successive abutment to facilitate the drive operation.

[0039] One of ordinary skill in the art will appreciate further features and advantages of the invention based on the above-described embodiments. Accordingly, the invention is not to be limited by what has been particularly shown and described. Rather, the invention covers all such changes and modifications as fall within the true spirit and scope of the invention, for which

letters patent is applied. All publications and references cited herein are expressly incorporated herein by reference in their entirety.

[0040] What is claimed is: